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# Genetic Testing for Defects and Performance Measures in Junior Livestock Show Hogs

***Kevin Heaton,*** Extension Faculty, ***Kelby Howard,*** Extension Intern**,** and ***Joshua Dallin,*** Extension Faculty

Junior livestock projects provide excellent opportunities for education and positive agricultural experiences for youth. As genetic testing advances become widely available to livestock producers, youth benefit by learning about the benefits and applications of genetic testing. Market and replacement hogs can be tested for genetic defects and for performance characteristics which influence reproduction, weight gains, livestock performance and meat quality.

Figure 1. Tissue Sampling Applicator.

## Genetic Evaluation

This fact sheet describes the sampling, testing and the genetic test results from the 2015 Kane and Garfield County junior livestock market show hogs. Tissue samples were collected from 35 hogs that were entered into the Garfield and Kane County junior livestock shows. The tissue samples were collected from the ear of each animal using an Allflex tissue sampling applicator (Figures 1, 2 and 3). The samples collected were sent to Geneseek to be tested for Porcine Stress Syndrome, Rendement Napole (RN), and Seek-Gain Total: Litter Size, Meat Quality, Growth and Feed Efficiency. A total of $2,975 ($85/hog) was spent on testing. After the results were received from Geneseek, each individual that participated in the show received a copy of the results for their individual animals.

Figure 2. Extracting Tissue Sample from a Hog.

Other methods of tissue sampling are possible such as taking ear notches or tail hair samples, which can be used to extract DNA. One concern, however, in extracting tissue samples for genetic testing is the possibility of cross contamination. With the Allflex tissue sampler, a new tissue sampling unit, with a vile and a punch, (Figure 3) is used on each animal to minimize cross contamination.

## Genetic Mutations: Porcine Stress Syndrome

Porcine stress syndrome (PSS) is an inherited neuromuscular disorder in pigs that is triggered by stressful situations, such as exercise, fighting, marketing, vaccination, castration, parturition, hot weather, etc. The symptoms exhibited by pigs experiencing PSS include muscle and tail tremors, labored and irregular breathing, blanching and reddening of the skin, rapid rise in body temperature, collapse, muscle rigidity and

Figure 3. Tissue Sampling Unit.

eventual death (Stradler & Conaster). Three of the 38 hogs (5.7%) are carriers of PSS (Table 1), which means that if they were to be bred with another carrier their offspring would potentially be affected by PSS. The recessive PSS gene is present in some of the show animals. Genetic selection has reduced the prevalence, but it still lingers and offers the potential for causing meat quality issues and mortality losses. By knowing which animals are carriers of PSS, producers are able to select non-carriers of PSS for breeding stock, thus eliminating PSS and avoiding problems with PSS from their herd. Youth can prevent potential losses of their market hog projects by avoiding PSS susceptible hogs and purchasing hogs from a breeder who utilizes genetic testing. Also, handling livestock calmly, humanely and free of stress prevents the disease from being expressed in live hogs.

## Genetic Mutation: Rendement Napole

Rendement Napole (RN) gene is found to cause low ultimate pH and water holding capacity (WHC) in pork, and occurs mainly in Hampshire purebred and Hampshire cross populations. Low water holding capacity results in poor quality meat which is referred to as Pale Soft Exudative (PSE) grade meat, which causes dry meat with low palatability when cooked. There are two possible alleles for the RN gene, one dominant mutant allele (RN-) and one recessive normal allele (rn+). Unlike the porcine stress syndrome (PSS), the RN- gene appears completely dominant. This dominance implies that a copy of the RN- gene inherited from even just one parent can cause poor meat quality. The negative effects of the RN gene on pork quality result in economic losses in the pork industry (Du, 2004). By understanding the effects of the mutant RN gene youth and producers are able to see the importance of selecting animals that do not have the mutant gene and are therefore more likely to produce higher quality meat. Of the 35 hogs, 29 (60%) tested are susceptible to low ultimate pH and water holding capacity, which raises a concern for market hog participants (Table 1.). Consumers purchase 4-H and FFA market hog projects at a premium and expect a high quality product in return. If 60% of market hogs are susceptible to PSS, youth, parents, junior livestock show committees should be aware of this issue and that the quality of the end product may be compromised.

## Genetic Combinations and Correlations

Another important issue to remember is that recessive genes can be additive and such is the case with PSS and RN. Research suggests the when pigs have both the PSS gene and the RN gene that the detrimental effects on pork quality is amplified (Hamilton, Ellis, Miller, McKeith, & Parrett, 2000).

**Table 1. The percent of hogs affected by Porcine Stress Syndrome (PSS) and Rendement Napole (RN) for Kane and Garfield junior livestock shows.**

| PSS | Garfield (%) | Kane (%) | RN | Garfield (%) | Kane (%) |
|---|---|---|---|---|---|
| Normal | 100 | 85 | rn+/rn+ Normal | 33 | 45 |
| Carrier | 0 | 15 | RN-/rn+ Heterozygous | 40 | 40 |
| | | | RN-/RN- Homozygous | 27 | 15 |

## Genetic Production: Seek-Gain

Seek-Gain utilizes DNA markers from eight unique genes that impact feed intake and conversion, weight gain, lean growth, fat content, meat quality, and litter size (Neogen Corporation). The majority of hogs tested had genes for high feed intake, gains, feed efficiency and improved fat deposition (Table 2.). Garfield County didn't have as many hogs with high gain traits as Kane County, but they had more hogs with balanced traits for gain and lean growth. Both Kane and Garfield County hogs were genetically prone for high feed intake, which improves weight gain. Kane and Garfield County hogs also were very similar in their fat

deposition and tend to deposit more back fat. Too lean of hogs was a problem in the late 80s and early 90s and since then the pork industry has made strides to improve pork to have moderate fat deposition.

**Table 2. The percent of hogs influenced by specific genes affecting productions traits such as growth, feed efficiency, feed intake, gain, and fat deposition.**

| MC4R | Garfield (%) | Kane (%) | CCKAR | Garfield (%) | Kane (%) | HMGA | Garfield (%) | Kane (%) |
|---|---|---|---|---|---|---|---|---|
| High Gain | 27 | 40 | High Feed Intake/Gain | 100 | 100 | High Back Fat Deposition | 100 | 100 |
| Lean Growth | 0 | 5 | | | | | | |
| Balanced | 73 | 55 | | | | | | |

Table 3 shows the genetic capacity for meat quality and consumer acceptance. Consumer surveys indicate that tenderness is one attribute of meat percieved to be a problem. Tenderness greatly influences palatability and consumer acceptibility (Pearson, 1994). Market hogs of the Kane and Garfield County livestock shows have good tenderness. Only 20% of the hogs were rated as being below average or potentially tough. Tenderness is important and other quality characteristics influence tenderness such as water holding capacity and cooking loss. In Garfield and Kane Counties, 87 and 85 percent of the hogs shows were below average for meat quality traits. These data suggest that there is substantial room for genetic improvement in the meat quality traits.

**Table 3. The percent of hogs influenced by specific genes affecting carcass and meat quality traits such as tenderness and juiciness.**

| CAST249 | Garfield (%) | Kane (%) | CAST638 | Garfield (%) | Kane (%) | PRKAG (Meat Quality) | Garfield (%) | Kane (%) |
|---|---|---|---|---|---|---|---|---|
| Tender | 40 | 40 | Tender | 47 | 40 | High | 0 | 0 |
| AVG | 40 | 40 | AVG | 33 | 50 | AVG | 13 | 15 |
| Tough | 20 | 20 | Tough | 20 | 10 | Low | 87 | 85 |

Both Kane and Garfield County junior livestock shows are terminal shows and have rules requiring all hogs to be harvested after the show. However, this project is planned to be as educational as possible and therefore each hog was tested to determine its reproductive merit. Approximately 30% of the hogs would have had low fertility if placed in a breeding herd, but most of them would have had average litter sizes (Table 4).

**Table 4. The Kane and Garfield County hog evaluation for specific genes influencing reproduction. This data assumes that all hogs would be used for breeding purposes, whereas in reality they were all harvested.**

| ESR | Garfield (%) | Kane (%) | EPOR | Garfield (%) | Kane (%) | |
|---|---|---|---|---|---|---|
| High Fertility | 13 | 20 | High Litter Size | 7 | 0 | |
| AVG Fertility | 60 | 35 | AVG Litter Size | 93 | 100 | |
| Low Fertility | 27 | 35 | Low Litter Size | 0 | 0 | |

## Conclusion

Producers, consumers and youth can all benefit from the genetic testing for defects in livestock animals. Producers use genetic testing to assure that their breeding animals are free of genetic defects, have highly productive traits and are genetically capable of producing high quality meat products. Consumers benefit by being the recipients of improved meat products. Youth participating in the Kane and Garfield County junior livestock projects are now more aware of the benefits and capabilities of genetic testing. This project identified specific genetic issues for Kane and Garfield County livestock show committees, youth and parents to address.

## Works Cited

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